

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Mark D. Elkovitch et al.)
) Group Art Unit: 1751
Serial No.:	10/797,298)
)
Filed:	March 9, 2004) Examiner: Thomas, Jaison P
)
For:	ELECTRICALLY CONDUCTIVE)
	COMPOSITIONS AND METHOD)
	OF MANUFACTURE THEREOF)

VIA ELECTRONIC FILING

Commissioner for Patents
P.O. Box 1450
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SUPPLEMENTAL APPEAL BRIEF

Please find enclosed a copy of a supplemental appeal brief pursuant to the communication received from the USPTO dated 10/17/2007. In this communication, the Examiner had stated that "Applicant has quoted Shibuta (WO/97/15934) on page 6, first full paragraph of the brief. However, the Office Actions dated 10/11/2006 and 3/13/2007 rejected the claims over Shibuta (WO/97/15935)."

Applicants would like to hereby state that International PCT Application Publication No. WO 97/15934 was introduced into this appeal brief because it teaches away from statements that the Examiner has attributed to WO 97/15935. In short, the Examiner has stated that WO 97/15935 teaches that titanium dioxide is electrically conducting. (see office action dated 10/11/2006) WO 97/15934, which is an application filed by the same inventor, concludes that titanium dioxide is electrically insulating. This contradicts the Examiner, which is why it was submitted.

If there are any additional charges with respect to this Supplemental Appeal Brief, please charge them to Deposit Account No. 50-1131.

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I. REAL PARTY IN INTEREST

The real party in interest in this appeal is the General Electric Company.

II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences known to Appellants, Appellants' legal representatives, or the assignee that will directly affect, be directly affected by, or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF THE CLAIMS

Claims 1 - 42 are pending in the application. Claims 25 - 40 and 42 have been withdrawn from consideration. Claims 1 - 17, 20 - 24, and 41 stand rejected. Claims 18 and 19 are objected to. Claims 1 - 42, as they currently stand, are set forth in Appendix A. Appellants hereby appeal the rejection of Claims 1 - 17, 20 - 24, and 41.

IV. STATUS OF THE AMENDMENTS

No amendments have been filed subsequent to the rejection of March 13, 2007. All prior amendments have been entered.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Articles made from polymeric resins are commonly utilized in material-handling and electronic devices such as packaging film, chip carriers, computers, printers and photocopier components where properties such as electrostatic dissipation or electromagnetic shielding are desirable. As electronic devices become smaller and faster, their sensitivity to electrostatic charges is increased and hence it is generally desirable to utilize polymeric resins that have been modified with electrically conducting fillers to provide improved electrostatically dissipative properties. In a similar manner, it is desirable to modify polymeric resins so that they can provide improved electromagnetic shielding while simultaneously retaining some or all of the advantageous mechanical properties of the polymeric resins.

Electrostatic dissipation (hereafter "ESD") is defined as the transfer of electrostatic charge between bodies at different potentials by direct contact or by an

induced electrostatic field. Electromagnetic shielding (hereafter "EM shielding") effectiveness is defined as the ratio (in decibels) of the proportion of an electromagnetic field incident upon the shield that is transmitted through it. Conductive fillers such as graphite fibers derived from pitch and polyacrylonitrile having diameters larger than 2 micrometers are often incorporated into polymeric resins to improve the electrical properties and achieve ESD and EM shielding. However, because of the large size of these graphite fibers, the incorporation of such fibers generally causes a decrease in the mechanical properties such as impact. Therefore it would be desirable to develop conductive polymeric compositions, which while providing adequate ESD and EM shielding, can retain their mechanical properties.

The invention is directed towards a composition which is electrically conductive, having an electrical volume resistivity less than or equal to about 10^8 ohm-cm, a notched Izod impact strength greater than or equal to about 5 kilojoules/square meter, and a Class A surface finish. The composition comprises a polymeric resin, an electrically insulating nanosized dispersion agent and carbon nanotubes. The polymeric resin may be selected from a wide variety of thermoplastic resins, blend of thermoplastic resins, or blends of thermoplastic resins with thermosetting resins. The polymeric resin may also be a blend of polymers, copolymers, terpolymers, or combinations comprising at least one of the foregoing polymeric resins. The carbon nanotubes used in the composition may be single wall carbon nanotubes (SWNTs), multiwall carbon nanotubes (MWNTs) or vapor grown carbon fibers (VGCF). The nanosized dispersion agents are electrically non-conducting. They are generally ceramic particles such as metal oxides, highly crosslinked silicones, polyhedral oligomeric silsesquioxanes (POSS) macromers, metal carbides, nanoclays and the like, which have maximum particle sizes less than or equal to about 1200 nm.

It is believed that the present composition has numerous advantages. The nanosized dispersion agent promotes the dispersion of the carbon nanotubes within the polymeric resin with minimal degradation to the aspect ratio of the carbon nanotubes. This permits the use of smaller amounts of carbon nanotubes in the composition while obtaining levels of electrical conductivity comparable with the use of larger quantities of carbon nanotubes. The use of smaller amounts of carbon nanotubes allows for the retention of intrinsic properties of the polymeric resin such as ductility, flexibility, impact

strength, and the like. Such compositions can be advantageously utilized in computers, electronic goods, semi-conductor components, circuit boards, or the like which need to be protected from electrostatic dissipation. They may also be used advantageously in automotive body panels both for interior and exterior components of automobiles that can be electrostatically painted if desired.

In addition, an article is described which comprises the inventive composition.

Independent Claim 1 is directed to an electrically conductive composition comprising a polymeric resin, a nanosized dispersion agent that is electrically non-conducting, and carbon nanotubes, wherein the composition has an electrical volume resistivity less than or equal to about 10^8 ohm-cm, and a notched Izod impact strength greater than or equal to about 5 kilojoules/square meter.

Support for the polymeric resin can be found on page 3, paragraph [0010] to page 4, paragraph [0012]. Support for the carbon nanotubes can be found on page 4, paragraph [0013] lines 1-3. Support for the electrically non-conducting nanosized dispersion agent can be found on page 13, paragraph [0036], lines 1-3. Support for the volume resistivity less than or equal to about 10^8 ohm-cm can be found on page 3, paragraph [0009], line 3. Support for the notched Izod impact strength greater than or equal to about 5 kilojoules/square meter can be found on page 3, paragraph [0009], line 4.

Independent Claim 41 is directed to an article manufactured from the inventive composition.

Support for the article can be found on page 22, paragraph [0059], lines 2-10.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1) Claims 1-17, 20-24, and 41 stand rejected under 35 U.S.C. § 102(b) as being anticipated by International PCT Application Publication No. WO 97/15935 to Shibuta, hereafter "Shibuta".

2) Claims 4-8 and 11-14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Shibuta, in view of Applied Nanotech Inc. (ANI) webpage (<http://www.applied-nanotech.com/cntproperties.htm>), hereafter "ANI".

VII. ARGUMENT

1. Claims 1-17, 20-24, and 41 are patentable under 35 U.S.C. § 102(b) over Shibuta.

In making the rejection, the Examiner has stated the following:

“With respect to the Shibuta rejections, applicant argues that Shibuta requires electrically conductive metal oxides whereas as the instant claims are directed towards non-conductive nanodispersion agents. Applicant further argues that the non-conductive powders that are disclosed in Shibuta are coated with a conductive surface and cites sections of Shibuta to support this position. The Examiner respectfully disagrees with the Applicant, because as stated in the prior office action, Shibuta teaches a composition that contains a polymeric resin, nanotubes, and metal oxides which are equivalent to the compositions that are claimed and disclosed in the Applicant’s specification. The metal oxides include titanium oxide and zinc oxide (see pg. 7, lines 11 and 12) used in Shibuta are identical to the nanodispersion agents disclosed in Applicant’s specification and claims (see instant Claim 23 and Specification, pg. 14, para. 0040). Therefore the nanodispersion agents of the instant claims and the metal oxides of Shibuta are identical and mere reference to claimed set as “non-conductive” and the prior art set as “conductive” does not change this fact. Further, the Examiner respectfully is unclear as to where Applicant believes the metal oxides of Shibuta are coated with a conductive surface. The Examiner has checked the sections cited by Applicant in his Remarks (particularly citations of Shibuta at pg. 7, lines 29-34 and pg. 8, lines 9-10) in the Shibuta PCT reference and has found no support for the statements that the said metal oxides from Shibuta are coated with any conductive surfaces.”

(Office Action dated March 13, 2007, pages 2-4.) Applicants respectfully disagree.

To anticipate a claim under 35 U.S.C. § 102, a single source must contain all of the elements of the claim. *Lewmar Marine Inc. v. Barient, Inc.*, 827 F.2d 744, 747, 3 U.S.P.Q.2d 1766, 1768 (Fed. Cir. 1987), *cert. denied*, 484 U.S. 1007 (1988).

Shibuta teaches a transparent electrically conductive film having a surface resistivity of 10^2 - 10^{10} ohm per square, an overall light transmittance of at least 70%, and a haze value of at most 20%. The film comprises an organic or inorganic transparent matrix having dispersed therein 0.01%-1wt% of hollow carbon microfibers and 1%-40wt% of an electrically conductive metal oxide powder (such as antimony-doped tin oxide) with an average primary particle diameter of 0.5 μ m or smaller (Shibuta, abstract.)

By emphasizing the use of electrically conductive particles, Shibuta teaches away from the presently claimed electrically non-conductive particles.

The Examiner has stated that the nanodispersion agents of the instant claims and the metal oxides of Shibuta are identical and mere reference to claimed set as “non-conductive” and the prior art set as “conductive” does not change this fact. The Examiner has further stated that the metal oxides include titanium oxide and zinc oxide (see pg. 7, lines 11 and 12) used in Shibuta are identical to the nanodispersion agents disclosed in Applicant’s specification and claims (see instant Claim 23 and Specification, pg. 14, para. 0040). Applicants respectfully submit that zinc oxide along with titanium oxide are generally known to be dielectric materials. Applicants respectfully cite International PCT Application Publication No. WO 97/15934 (see Appendix B) to Shibuta, hereafter “Shibuta ‘934”, filed on the same date as Shibuta. Shibuta ‘934 teaches an electrically conductive polymer composition comprising an organic polymer, hollow carbon microfibers, and an electrically conductive white powder (such as TiO₂ powder coated with antimony-doped tin oxide or aluminum-doped zinc oxide powder) (Shibuta ‘934, abstract.) Shibuta discloses:

“examples of a surface-coated conductive white powder (2) are nonconductive white powders such as titanium oxide, zinc oxide, silica, aluminum oxide, magnesium oxide, zirconium oxide, a titanate of an alkali metal (such as potassium titanate), aluminum borate, barium sulfate, and synthetic fluoromica with the surface thereof coated with a transparent or white electrically conductive metal oxide such as ATO, AZO, or ITO. Titanium oxide is most preferred as the nonconductive white powder because its coloring ability is greatest, but others can be used alone or in combination with titanium oxide. ATO and AZO are preferred as the conductive metal oxide for surface coating because they have good covering properties.”

(emphasis added, Shibuta ‘934, page 8, lines 9-20.) Thus, Applicants respectfully assert that Shibuta ‘934 teaches that titanium oxide and zinc oxide are non-conductive, and in order to render them conductive they are coated with an electrically conductive metal oxide. Applicants respectfully submit that Shibuta’s oversight at disclosing titanium oxide and zinc oxide as conductive materials is a direct contradiction of Shibuta ‘934, and also a contradiction of the fact that titanium oxide and zinc oxide are both known to be dielectric materials. Applicants respectfully submit that Shibuta’s mischaracterization

of titanium oxide and zinc oxide as conductive materials may stem from the teaching that they can be rendered electrically conductive by doping them with a different element to produce an oxygen deficiency, for example, Al and In to zinc oxide, and Nb and Ta to titanium oxide (Shibuta, page 7, lines 3-9.)

Thus, Applicants respectfully assert that titanium oxide and zinc oxide are not conductive as evidenced by Shibuta '934 and by Applicants' Specification. Shibuta does not teach all the elements of Applicants' independent claim 1, specifically that the nanosized dispersion agent is electrically non-conducting. Shibuta, thus, does not anticipate the instant claims, and the instant claims are patentable over Shibuta.

2. Claims 4-8 and 11-14 are patentable under 35 U.S.C. § 103(a) over Shibuta in view of ANI.

Shibuta is discussed above. ANI teaches physical, mechanical, and other properties of carbon nanotubes (ANI, and links therein.) ANI does not remedy the lack of teaching of an electrically non-conducting dispersion agent in Shibuta.

For an obviousness rejection to be proper, the Examiner must meet the burden of establishing a *prima facie* case of obviousness, i.e., that all elements of the invention are disclosed in the prior art; that the prior art relied upon, coupled with knowledge generally available in the art at the time of the invention, contain some suggestion or incentive that would have motivated the skilled artisan to modify a reference or combined references; and that the proposed modification of the prior art had a reasonable expectation of success, determined from the vantage point of the skilled artisan at the time the invention was made. *In re Fine*, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988); *In Re Wilson*, 165 U.S.P.Q. 494, 496 (C.C.P.A. 1970); *Amgen v. Chugai Pharmaceuticals Co.*, 927 U.S.P.Q.2d, 1016, 1023 (Fed. Cir. 1996).

Applicants respectfully assert that in view of the remarks above regarding Shibuta, and in light of the disclosure of Shibuta '934, there is no teaching or suggestion in Shibuta, ANI, or the combination of both references to use a nanosized dispersion agent that is electrically non-conducting as required by Applicants' independent claim 1. Thus, the combination of the cited references does not teach or suggest all the elements of

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independent claim 1, a prima facie case of obviousness has not been established, and the instant claims are patentable over Shibuta in view of ANI.

VIII. CLAIMS APPENDIX

APPENDIX A

1. (Previously Presented) An electrically conductive composition comprising:

a polymeric resin;

a nanosized dispersion agent that is electrically non-conducting; and

carbon nanotubes, wherein the composition has an electrical volume resistivity less than or equal to about 10^8 ohm-cm, and a notched Izod impact strength greater than or equal to about 5 kilojoules/square meter.
2. (Original) The composition of Claim 1, wherein the carbon nanotubes are single wall carbon nanotubes, multiwall carbon nanotubes, vapor grown carbon fibers or a combination comprising at least one of the foregoing types of carbon nanotubes.
3. (Original) The composition of Claim 1, wherein the carbon nanotubes have an inherent electrical conductivity of about 10^4 Siemens/centimeter.
4. (Original) The composition of Claim 1, wherein the composition has an electron-transport mechanism that is ballistic.
5. (Original) The composition of Claim 1, wherein the carbon nanotubes exist in the form of ropes of at least about 10 carbon nanotubes prior to processing.
6. (Original) The composition of Claim 1, wherein the carbon nanotubes exist in the form of ropes of at least about 100 carbon nanotubes prior to processing.
7. (Original) The composition of Claim 1, wherein the carbon nanotubes exist in the form of ropes of at least about 1000 carbon nanotubes prior to processing.
8. (Original) The composition of Claim 1, wherein the carbon nanotubes exist in the form of ropes of at least about 10000 carbon nanotubes prior to processing.

9. (Original) The composition of Claim 1, wherein the carbon nanotubes comprise up to about 80 wt% impurities, wherein the impurities are iron, iron oxides, yttrium, cadmium, nickel, cobalt, copper, soot, amorphous carbon, multi-wall carbon nanotubes, or a combination comprising at least one of the foregoing impurities.

10. (Original) The composition of Claim 2, wherein the single wall carbon nanotubes comprise up to about 80 wt% impurities, wherein the impurities are iron, iron oxides, yttrium, cadmium, nickel, cobalt, copper, soot, amorphous carbon, multi-wall carbon nanotubes, or a combination comprising at least one of the foregoing impurities.

11. (Original) The composition of Claim 1, wherein the carbon nanotubes are metallic, semi-conducting, or a combination comprising at least one of the foregoing carbon nanotubes.

12. (Original) The composition of Claim 11, wherein the carbon nanotubes comprise about 1 to about 99.99 wt% metallic carbon nanotubes.

13. (Original) The composition of Claim 11, wherein the carbon nanotubes comprise about 1 to about 99.99 wt% semi-conducting carbon nanotubes.

14. (Original) The composition of Claim 1, wherein the nanotubes are armchair nanotubes, zigzag nanotubes, or a combination comprising at least one of the foregoing nanotubes.

15. (Original) The composition of Claim 1, wherein the carbon nanotubes comprise about 1 to about 80 wt% impurities.

16. (Original) The composition of Claim 1, wherein the polymeric resin is a blend of polymers, a copolymer, a terpolymer or a combination comprising at least one of the foregoing polymeric resins.

17. (Original) The composition of Claim 16, wherein the polymeric resin has a phase separated morphology and wherein a substantial proportion of the carbon nanotubes are present in a single phase of the blend.

18. (Original) The composition of Claim 1, wherein the carbon nanotubes are derivatized with functional groups.

19. (Original) The composition of Claim 1, wherein the carbon nanotubes are derivatized with functional groups either on a side-wall or on a hemispherical end.

20. (Original) The composition of Claim 1, wherein the carbon nanotubes have no hemispherical ends attached thereto or have at least one hemispherical end attached thereto.

21. (Original) The composition of Claim 1, wherein the nanosized dispersion agents are metal oxides, polyhedral oligomeric silsesquioxanes macromers, highly crosslinked silicone nanosized agents, metal carbides, nanoclays having an average particle size of less than or equal to about 1200 nanometers.

22. (Original) The composition of Claim 1, wherein the nanosized dispersion agents is a metal oxide of an alkali earth metals, an alkaline earth metals, a transition metals or a combination comprising at least one of the foregoing metal oxides.

23. (Original) The composition of Claim 22, wherein the metal oxide is a aluminum oxide, magnesium oxide, calcium oxide, copper oxide, zinc oxide, titanium oxide or a combination comprising at least one of the foregoing oxides.

24. (Original) The composition of Claim 1, comprising about 0.01 to about 20 wt% nanosized dispersion agents based on the total weight of the composition.

25. (Withdrawn) A method for manufacturing a composition comprising:

blending a polymeric resin, nanosized dispersion agent and carbon nanotubes, wherein the composition has an electrical volume resistivity less than or equal to about 10^8 ohm-cm, and a notched Izod impact strength greater than or equal to about 5 kilojoules/square meter.

26. (Withdrawn) The method of Claim 25, wherein the blending comprises melt blending, solution blending or combinations comprising at least one of the foregoing methods of blending.

27. (Withdrawn) The method of Claim 25, wherein the polymeric resin is synthesized from monomers, dimers, trimers or a combination comprising at least one of the foregoing monomers, dimers or trimers during the process of blending.

28. (Withdrawn) The method of Claim 25, wherein the carbon nanotubes are sonicated in the presence of the monomer prior to the polymerization of the polymer.

29. (Withdrawn) The method of Claim 25, wherein the polymeric resin is semi-crystalline or amorphous and has a molecular weight of about 100g/mole to about 1,000,000 g/mole.

30. (Withdrawn) The method of Claim 25, wherein the blending involves the use of shear force, extensional force, compressive force, ultrasonic energy, electromagnetic energy, thermal energy or combinations comprising at least one of the foregoing forces and energies and is conducted in processing equipment wherein the aforementioned forces are exerted by a single screw, multiple screws, intermeshing co-rotating or counter rotating screws, non-intermeshing co-rotating or counter rotating screws, reciprocating screws, screws with pins, barrels with pins, screen packs, rolls, rams, helical rotors, or combinations comprising at least one of the foregoing.

31. (Withdrawn) The method of Claim 25, wherein the blending involves extrusion and wherein the single wall carbon nanotubes or the nanosized dispersion agent or both are fed downstream as a masterbatch into the extruder.

32. (Withdrawn) The method of Claim 25, wherein the composition is further subjected to ultradrawing in the uniaxial direction utilizing draw ratios of about 2 to about 1,000,000.

33. (Withdrawn) The method of Claim 25, wherein the composition is further stressed uniaxially or biaxially to produce a film having a thickness of about 0.01 micrometers to about 5000 micrometers.

34. (Withdrawn) The method of Claim 25, wherein the composition is further supercooled to a temperature of about 1°C to about 100°C below the melting point after the blending for a time period of about 2 minutes to about 2 hours.

35. (Withdrawn) The method of Claim 25, wherein the blending comprises melt blending or solution blending, and wherein the blending utilizes a fluid in the liquid state, the gaseous state, the supercritical state or combinations comprising at least one of the foregoing states.

36. (Withdrawn) The method of Claim 25, wherein the energy utilized for the blending is an amount of about 0.1 kwhr/kg to about 10 kwhr/kg.

37. (Withdrawn) The method of Claim 25, wherein the nanosized dispersion agents are metal oxides, polyhedral oligomeric silsesquioxanes macromers, metal carbides, highly crosslinked silicone nanosized agents, nanoclays having an average particle size of less than or equal to about 1200 nanometers.

38. (Withdrawn) The method of Claim 25, wherein the nanosized dispersion agents is a metal oxide of an alkali earth metals, an alkaline earth metals, a transition metals or a combination comprising at least one of the foregoing metal oxides.

39. (Withdrawn) The method of Claim 25, wherein the metal oxide is a aluminum oxide, magnesium oxide, calcium oxide, copper oxide, zinc oxide, titanium oxide or a combination comprising at least one of the foregoing oxides.

40. (Withdrawn) The method of Claim 25, wherein the composition comprises about 0.01 to about 20 wt% of the nanosized dispersion agents based on the total weight of the composition.

41. (Original) An article manufactured from the composition of Claim 1.

42. (Withdrawn) An article manufactured by the method of Claim 25.

IX. EVIDENCE APPENDIX

No additional evidence is submitted herein.

X. RELATED PROCEEDINGS APPENDIX

There have been no related proceedings in connection with this appeal brief. As a result there are no decisions rendered by a court or the Board pursuant to paragraph (c)(1)(ii) of this section.

XI. CONCLUSION

Thus the Examiner's rejections of claims 1-17, 20-24, and 41 under 35 U.S.C. § 102(b) and of claims 4-8 and 11-14 under 35 U.S.C. § 103(a) should be reversed, and Claims 1-17, 20-24, and 41 should be allowed.

In summary, the references cited by the Examiner (PCT Application Publication No. WO 97/15935 and Applied Nanotech Inc. (ANI) webpage) do not disclose or suggest the following features of independent claim 1, in particular:

- a nanosized dispersion agent that is electrically non-conducting.

In view of the foregoing, Appellants respectfully submit that all of the claims are allowable and the application is in condition for allowance. Appellants respectfully request reversal of the outstanding rejections and allowance of this application.

In the event the Examiner has any queries regarding the submitted arguments, the undersigned respectfully requests the courtesy of a telephone conference to discuss any matters in need of attention.

If there are any additional charges with respect to this Appeal Brief, please charge them to Deposit Account No. 50-1131.

Respectfully submitted,

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